Memo For: Jack Hayes—Chief, Office of Science and Technology

From: IFPS Science Steering Team

Subject: ISST Position on Declaring NDFD Elements Official

The NWS is facing a critical decision point in the implementation of the NDFD. Leading up to 14 September, the agency must decide which NDFD elements will become official on 1 December – a date already a result of previous postponements of this decision. Extensive NOAA resources continue to be dedicated to system development and subsequent refinements. Most recently, the efforts of the DSPO teams have been targeted at developing detailed program development timelines and key decision points needed to implement a consistent approach to integrate NDFD into operations. You are also aware of the work and accomplishments of the ISST, including overseeing the successful implementation of DGEX. Many of the ISST efforts are founded on the requirements and recommendations of the WR SOO/DOH Whitepaper team, which initiated its work way back in May of 2002. However, few can argue with the fact that much more work is needed. Development of an Analysis of Record, long agreed as a key to an effective verification system, is just one example of what is left to be done.

Considering the digital forecast system as it exists today, or may change in the coming months prior to 1 December, is the agency ready to declare NDFD elements official so as to allow agency partners and customers to invest their resources in using the digital forecast database in critical decision making situations? Preliminary external feedback on the technical quality of NDFD graphics might suggest we are. A majority of the responses obtained between 7 October 2003 and 18 June 2004 found the overall technical quality of the NDFD to be highly satisfactory (see Glen Austin's brief at recent Partner's Workshop). Just how good are these forecasts? Namely, are they complete, timely, and always available? Are we satisfying established thresholds for spatial consistency? Is there sufficient inter-element consistency? Work is ongoing to answer these questions, many of which can be resolved through establishing methodologies, "Smart Tools," and hardware upgrades. The STSIT is currently working on these aspects and will be providing a brief this week. However, not to be overlooked but likely more difficult to answer, are the following questions critical to the ISST's position on this important decision, and that the team feels have not been adequately addressed:

- **What are we forecasting?**
- **What is considered an acceptably accurate forecast?**
- **How accurate are these digital forecasts?**

The ISST feels these questions *must* be addressed, at least preliminarily, in order to declare any NDFD elements official. Further, this information must be provided to system users -- much like a business releases an initial software version to the customer, and accompanies this release with information on known bugs and planned system improvements.

Unfortunately, extensive work is still needed to address these questions. The ISST is currently reviewing NWS Directive 10-506, primarily to more accurately define NDFD elements and thereby ensure their scientific integrity. A key result of this effort will be to help avoid element misinterpretation (e.g., grid point versus grid box average; see the WR SOO/DOH Whitepaper Implementation Report, Overarching Requirement 1). This is critical for forecasters generating these grids, and most importantly for the users of these grids, some of whom may – or even already have – conducted forecast verification efforts on their own.

To date, little if any has been done to define standards of acceptable product accuracy. MDL currently compares NDFD (point-based) verification metrics against Model Output Statistics (MOS). Comparing against numerical guidance is just one method to define product accuracy. Other benchmark methods include comparing against climatology and persistence. Standards of forecast accuracy not only help guide possible system improvements, they convey critical system accuracy information to users investing resources and making decisions based on these forecasts. The DSPO Assessment Team charge number 5, which is to define acceptable standards for what constitutes an acceptable forecast, has not been properly addressed. To the ISST's knowledge, many of the actions within this charge have not been completed, let alone defined in the necessary greater detail. This charge can serve as a foundation for efforts that must begin immediately in order to provide this information by a potential declaration date of 1 December.

Efforts to determine current forecast system accuracy have also been undertaken, but are incomplete. These include work at MDL, which is primarily point based (experimental grid-based verification work with the 20-km RUC is also ongoing), and grid-based work by John Horel at the University of Utah. MDL comparison of NDFD forecasts at point locations coincident with MOS points – 1279 locations total across the CONUS – has revealed interesting numbers that would lead one to believe system accuracy is sufficient across most elements. However, the metrics used, primarily MAE and Bias, and restricting the method to MOS points, can only provide a glimpse into system performance. As an example, John Horel has measured system accuracy based on anomaly correlations (i.e., how well the forecast pattern was captured), and found temperature forecasts only exhibited skill (defined here as 50% or greater correlation) out to 3 days, dewpoint out 1.5 days, and wind speed only during the first day. John's NDFD verification work, which is especially revealing considering it was performed over complex terrain and using the high-density MesoWest network, shows us just how much work is needed to improve forecast system accuracy.

Despite the fact there is, and always will be, more system work needed to allow us to produce the most accurate forecasts possible, continual delays in declaring any NDFD element official can be considered more detrimental to the relationships built between the agency and its customers and partners when weighed against the alternative approach of declaring at least part of the NDFD elements official, despite known system deficiencies and forecast inaccuracies. At a minimum however, upon declaring an element official

the agency must provide answers – even if partial and preliminary – to the aforementioned questions.

In summary – assuming many of the system issues are resolved, namely obtaining and installing a sufficient NDFD backup server, ensuring inter-element consistency, and developing or instituting methods to use consistency check, completeness and timeliness software or tools, the issues surrounding forecast accuracy must be properly addressed before any NDFD element is declared official.

To conform to the 30 June Public Information Statement, whereby it was stated that "…SEVERAL IF NOT ALL THE FOLLOWING ELEMENTS…(element list)…WILL BECOME OFFICIAL PRODUCTS", the ISST recommends at least a subset of elements be declared as official, and assuming it is feasible to declare a partial set, and not all, official. These elements are: MaxT, MinT, and PoP12. In order to provide a more complete weather picture for digital database users, Wx should also be included in this partial list. It is understood, however, that we are still not performing our best in producing these elements, especially in high-impact, critical threshold forecasting situations (e.g., land-falling tropical systems).

This recommendation is made with a requirement that efforts be made to accompany each of these elements with appropriate standards of forecast quality, and at least a preliminary measure of forecast performance. NWS customers and partners must be provided with this information, along with information on work to be completed to declare the remaining NDFD elements official. This includes creating and implementing a effective verification system for these elements; many of which, such as sky cover and QPF, do not even have any verification system in place right now. The ISST's position paper, *IFPS Era Forecast Verification: Endorsements, Requirements, and Recommendations",* dated 2 April 2004, can serve as a comprehensively guiding document for such work.